August 11, 2005

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Dear Mr. Neal and National Organic Standards Board:

This letter is in reference to the National Organic Program, Sunset Review, Docket number TM-04-07. Midwestern Bio-Ag Products and Services, Inc. supports the continued allowance of the following substance(s):

Name of Substance	Location on National List	Reason for continued allowance.	Supporting Documents
Elemental Sulfur	§ 205.601(j)(2)	plant nutrient and soil quality	Addendum A
Humic Acids	§ 205.601 (j)(3)	improves soil quality, reduce stress on crops, chelates nutrients, improve the uptake of plant nutrients, buffer soil pH, increase soil water holding capacity	Addendum B
Lignin sulfonate	§ 205.601(j)(4)	chelating agent, dust suppressant, no alternative	Addendum C
Magnesium sulfate	§ 205.601(j)(5)	some soils need supplemental magnesium	Addendum D
Micronutrients	§ 205.601(j)(6)	crop and livestock forage quality, soil nutrient balance, no alternatives	Addendum E
Soluble boron products	§ 205.601(j)(6)(I)	crucial to crop quality, crop growth, soil nutrient utilization and seed production, widespread deficiencies.	Addendum F
Sulfates, carbonates, oxides or silicates of zinc, copper, iron, manganese, molybdenum, selenium and cobalt.	§ 205.601(j)(6)(ii)	crop and livestock forage quality	Addendum G

Respectfully,

Lawrence Mayhew
Research and Development

Cc: Organic Trade Association
National Organic Standards Board

Addendum A

Elemental Sulfur

We support the use of elemental sulfur because it is an essential element for plant growth used to initiate biological reactions and interactions in soil systems that otherwise would not occur.

Historically, elemental sulfur has been used when there is a need for soil sulfur in soils that are too alkaline (high pH) to justify using any other sulfur source. The ability of elemental sulfur to reduce soil alkalinity and release tied up nutrients is well documented. The amelioration of high pH soils with elemental sulfur is caused by the oxidation of the sulfur by sulfate oxidizing bacteria. The quantification of those reactions was done by Nor and Tabatabai (1977). Additionally, the use of elemental sulfur as a source of sulfur results in appreciably less leaching of sulfur into the environment compared to other common sources of sulfur, such as gypsum (Lefroy et al, 1994).

The bioavailability of rock phosphates, which are very difficult to dissolve, can be increased by the addition of elemental sulfur (Cantin et al, 1999). When the elemental sulfur is acted upon by microbes, the resulting sulfuric acid produced by microbial action will acidulate the rock phosphate. The biological oxidation of the elemental sulfur by ubiquitous soil bacteria (for example, Thiobacillus spp.) produces sulfuric acid, which reacts with apatite (the primary calcium phosphate mineral found in rock phosphates), releasing plant bioavailable calcium (Ca^{2+}) and phosphate (PO_4^{3-}) into the soil solution. The biological oxidation of sulfur and subsequent release of phosphate creates a “priming effect” as described by DeSwart and van Diest (1987), thus leading to a cascading effect of biological reactions which increases the bioavailability of the rock phosphates in soil systems.

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Addendum B

Humic substances

We support the listing of humic substances as allowed synthetics because of the extensive benefits derived from their use, which are consistent with the ecological and sustainable goals of organic system plans.

Humic substances are the most ubiquitous carbon substance on the surface of the earth, found in almost every drop of water and in almost all soils. Humic substances are the most widely distributed organic products of biosynthesis on the face of the earth (Tan, 2003), exceeding the amount of carbon contained in all living organisms by approximately one order of magnitude (Steinberg, 2003).

The benefits of humic substances are extensive;

- can acidify otherwise insoluble rock phosphates releasing plant available calcium and phosphorus (Sinha, 1971; Sinha, 1972, Lobartini et al, 1998), thus eliminating the energy intensive acidulation and waste associated with the production of phosphate fertilizers
- will stabilize plant available nutrients while inhibiting their precipitation back into the environment as potential pollutants (Banfield and Hamers, 1997; Schnitzer, 1986).
- improve soil aggregate stability, especially when combined with sulfur (Piccolo and Mbagwu, 1999)
- act as a storehouse of nitrogen, phosphorus, sulfur, and zinc (Stevenson, 1994; Frank and Roeth, 1996)
- improve water holding capacity for better drought resistance and aid in the reduction of water usage (Russo and Berlyn, 1990)
- they stimulate growth by improving the uptake of micronutrients (Chen et al, 2001; Chen et al, 1999).
- improved nitrogen utilization by plants and stimulatory effects have been studied extensively at USDA-ARS soil lab in Minneapolis (Clapp et al, 2001)
- stabilize soil nitrogen (Thorn and Makita, 2000; Kelly and Stevenson, 1994; Nardi, et al, 1996)
- reduce the need for nitrogen and phosphorus fertilizers. (Day, et al, 2000; Fataftah, et al, 2001)
- stimulate root growth (Chen and Aviad, 1990; Nardi, et al, 1996; Abad et al, 1991;Amarasiriwardena et al, 2000; MacCarthy, et al, 1990, Chen et al, 2001)
- enhanced uptake of macronutrients, such as nitrogen, phosphorus, sulfur (Chen and Aviad, 1990) and micronutrients, i.e. Fe, Zn, Cu and Mn. (Chen et al, 1999)
- enhanced mineral nutrient uptake by increasing in root mass (Kapulnik, 1996)
- enhanced uptake of minerals through the stimulation of microbiological activity. (Albuzio et al, 1994; Figliolia et al, 1994; Visser, 1995; Nardi, et al, 1996; Paciolla, et al, 1998: Day et al, 2000)
- remove toxins from both soils and animals (Orlov et al, 1994;Clapp et al, 2001a)

We interpret the annotation *"naturally occurring deposits"* to be self-explanatory. So we are puzzled why a naturally occurring deposit would be listed in the synthetic section. Naturally occurring deposits of Leonardite (oxidized lignite) have been interpreted to be approved non-synthetic mined materials of low solubility.

The annotation "*water and alkali extracts only*" is difficult to interpret because humic acid can be either **operationally defined** or it can be analyzed in respect to **standard reference materials**. The two characterizations are significantly different. Furthermore, the annotation does not mention two other extracts, fulvic acid and humin, that accompany humic acid during the extraction process, are chemically similar, may or may not be included in the humic acid extract and are traditionally used in organic plans.

The traditionally accepted operational definition of humic acid, fulvic acid and humin is based entirely on their solubility in aqueous (water) solutions at various pH. This is much like defining common table salt as "the remaining solids left over from the evaporation of salt water". One would say that the remaining material after evaporation is operationally defined instead of calling it what it really is; sodium chloride. In other words, an operationally defined substance imparts no information about the chemical composition or reactivity of a substance.

Historically, aqueous potassium hydroxide (lye) has been the strong alkali used by manufacturers to extract “humic acid” from Leonardite, a natural source of humic substances. About 200 years ago, the names humic acid, fulvic acid and humin were used to describe what was believed to be three distinct fractions of humic substances. The three fractions were separated from various materials by using “classical” extraction techniques with aqueous (water) solutions (Schnitzer, 1999).

The extraction process typically begins with humic bearing materials that are treated with a strong alkali (base), then an acid is added. The acid causes a coagulated black sludge-like material to precipitate out of solution. The name of the precipitate is “humic acid”. Because it can also be described as the product of adding an acid (natural Leonardite is acidic) to an alkaline solution, it is a “salt”. Therefore, the word “humate” may be more appropriate.

The remaining materials that survive the alkali / acid treatment consist of an acidic liquid and an insoluble solid. The liquid is typically named “fulvic acid” and the solid, which is unaffected by the treatments, is named “humin”. The humin fraction, which is not soluble in acid nor alkali, has been described as acting like a sponge, soaking up nutrients (Karr, 2002) on surfaces which are capable of nutrient exchangeability between the material and soil matrices, therefore having a place in sustainable agriculture.

What is Humic Acid?

The interpretation of humic acid is confusing in that the NOP has not established standardized analytical procedures for fulvic acid, humic acid and humin. The industry has not adopted standards for defining humic substances either, making it difficult to determine what a manufacturer is guaranteeing on a product label. There are numerous analyses referenced by manufacturers, and many of them may be invalid because of procedural problems during extraction and the need for separating the products of the reacted materials.

For example, the more popular analytical procedures use strong alkali as a solvent, but they take no precautions to prevent re-associations of free radicals that are produced during the extraction process. Some scientists argue that the reaction products are complex degradation products formed within the extraction solutions, stripped of many of the original functional groups and recombined into an indescribable material (Pokorna et al, 2001).

Keep in mind that the structure of humic substances changes radically with just slight changes in pH and / or the type of metals present. (Kolla, 1998; Piccolo et al, 2000). Therefore, the use of strong alkali, i.e. potassium hydroxide, certainly subjects humic substances to extreme pH conditions, and the amount and kind of metals as accessory minerals in the humic bearing materials will produce chemically different kinds of extraction products.

Hayes and Graham (2000) report the fundamental composition of humin to be the same as humic acid and fulvic acid. They say that humin may be a humic substance in association with mineral oxides or hydroxides (from the reaction). Alternatively, humin may be coated with hydrocarbons or lipids (fats) that were stripped during the reaction, making it insoluble to aqueous solvents. Nobody really knows for sure.

^{13}Carbon Nuclear Magnetic Resonance and Mass Spectrometric Analyses have revealed that the main structural features of humic acid, fulvic acid and humin are nearly identical, and humic substances from different sources are essentially the same. (Pokorna et al, 1999; Cook and Langford, 1999; Gajdosova, 2000). Reported variations in plant response to different sources of humic substances are rare and unconfirmed.

Chemical Analysis of Humic Substances: In Search of a Standard

The primary reason why there is so much confusion about humic substances is the fact that the common procedures used to analyze them are based on “classical” aqueous extraction. Unless contaminants are removed from a sample of humic material and unless the extractions are separated by special procedures, and if the extractions are not performed under “inert” conditions, the extracted substances may contain anything from amino acids, proteins, sugars or fatty acids in addition to the humic and fulvic acids (Hayes and Graham, 2000).

For example, if minerals are present in the parent material (which is typical), the metals present are complexed by humic substances, allowing both humic and non-humic material to be solubilized during extraction (Ozdoba, et al, 2001).

CDFA Method: A large percentage of manufacturers and suppliers are using the services of A&L Western Agricultural Laboratories, Inc. to determine the quality of their humic substances. A&L offers two methodologies for humic substance analysis; the California Department of Food and Agriculture method (CDFA) and the A&L Western Method. The CDFA Method is supposed to be a quantitative analysis of humic acid. This method reports the acid insoluble fraction of humic material.

However, the CDFA method, which is based on the operational definition of humic acid, allows the liquid fulvic fraction to remain in contact with the solid humic acid fraction (exposed to the air) were uncontrolled reactions can take place. The remaining solution pH is adjusted to "*between 1 and 2*", increasing the potential for inconsistent results because humic substances are very sensitive to changes in pH.

A&L Western Method: this method is a qualitative analysis, which reports only the alkaline soluble portion of a material. It consistently reports a higher percentage of "humic acid" than the CDFA method and cannot be converted to a "dry basis". Since only an alkaline extraction is used, both humic and non-humic substances are extracted by the process, making the A&L Western method an unreliable test.

Both methods more than likely include non-humic materials in the analysis and cannot produce consistent results because both the CDFA and the A&L methods use a strong alkali extraction procedure that exposes the extractions to the air, do not remove contaminants before extraction, and do not prevent the extracted materials from recombining with the free radicals in the extraction solutions.

In our experience, the reported "humic acid" for identical samples sent to the same lab has been significantly inconsistent and the variability among labs performing the same procedure on identical materials produced an even wider range of variability.

The IHSS Analysis

We recommend the NOSB adopt the International Humic Substances Society (IHSS) method for analyzing humic substances, which removes contaminants prior to extraction, is performed in an inert atmosphere, prevents contamination of the reaction products and reports both humic acid and fulvic acid fractions. The IHSS method is published in the Standard Methods for Soil Analysis of the Soil Science Society of America (SSSA), Madison, Wisconsin (Swift, 1996). The IHSS method is supported by SSSA because it reportedly produces repeatable, consistent results and can be performed in most laboratories.

We are only aware of one laboratory set up to run humic substances analysis based on IHSS protocols on a commercial basis at a reasonable cost; EarthFax Engineering, Midvale, UT 84047, (435-787-2743), a soil reclamation, civil, geotechnical and environmental engineering firm. EarthFax Engineering is an independent laboratory and not associated with Midwestern Bio-Ag in any way.

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Addendum C

Lignin sulfonate

We support the listing of lignin sulfonate as an approved synthetic used as a chelating agent and dust suppressant. Lignin sulfonate is generally regarded as safe by the FDA (21CFR § 573.600) and is an approved additive in animal feed (AAFCO, 2002). It has proven to be particularly useful when mixed with organic fertilizers during the agglomeration (granulation, pelletizing) of soil fertilizers and amendments. Agglomeration is a means of rolling materials into small aggregates 1 to 2 mm in diameter to ease the transportation, handling and application of materials to soils and to reduce or eliminate dust from many naturally mined minerals. Some high carbon materials, such as Leonardite and composted chicken manure, are almost impossible to handle because of their extreme dustiness. By agglomerating these high carbon materials, more precise application to fields is possible while controlling dust.

Gypsum and limestone were the first materials to be agglomerated for agricultural application over twenty years ago. It is common knowledge, confirmed by Scott et al (1992), that finer particles are more readily utilized in a shorter time period than coarser materials. Because the effectiveness of limestone is improved by grinding the stone into a fine material, the coarseness of the stone must be declared on the label as part of registering limestone products in most states. However, the fine materials create a great deal of fugitive dust and are almost impossible to broadcast over fields unless they are agglomerated.

Because many of our customers export to Japan, and because lignin sulfonate is not approved under the Japanese Agricultural Standards for organic production, we have extensively researched alternative materials to use and are continually researching other materials. To date, no other effective material has been found to replace lignin sulfonate.

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Addendum D

Magnesium Sulfate

We support the continuation of magnesium sulfate on the list of synthetics for organic crop production because there are some soils that need additional magnesium. As there are no organically produced, economically feasible forms of magnesium, or naturally occurring materials that contain only magnesium as the major element, the synthetic form should be used.

However, we feel that the “deficiency” restriction placed on magnesium sulfate when interpreted within the context of an organic system plan, is inconsistent with the goals of the Organic Food Production Act, which requires maintaining or improving soil. Please see the comments regarding the restriction on micronutrients in Addendum E below.

Reducing the interpretation of “deficiency” to what quantity of nutrient is “sufficient” for plants (as per conventional agricultural dogma) is not a proper criteria for determining soil nutrient balance within complex agroecosystems. In order for organic plans to succeed, they must consider soil nutrient balance as well as quantity (Phelan, 2004). The mineral balance and content of soils, food and forage are critical to ecosystem, livestock and human health. For example, if there is sufficient magnesium for plants to survive, creating a low level in forages, livestock will suffer, requiring expensive synthetic therapy. If humans eat the livestock that have a magnesium imbalance, it may lead to pathogenic conditions within the human population.

Soil interactions must also be factored into the determination of what constitutes sufficiency of soil nutrients. For example, aluminum competes with magnesium during mineral uptake by plant roots (Marschner, 1999), therefor soil concentration of magnesium may not be high enough to effectively compete for exchange sites on soil components that are saturated with aluminum. Numerous elements are antagonistic to magnesium uptake (Kabata-Pendias, 2000). The presence of antagonistic elements may require the additional of a nutrient in order to overcome the potential for deficiencies, despite the fact that a soil test reveals what may be interpreted as “sufficient” quantity of a single element (Olson, 1972),

Plants will survive despite an imbalance of magnesium and aluminum, albeit with some difficulties, and low levels of magnesium in relation to aluminum in humans has been implicated in numerous diseases, especially Alzheimer’s disease (Glick, 1990; Durlach, 1990).

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Addendum E

Micronutrients

Since the early 1920's, when manganese and boron were first determined to be essential for plant growth, the importance of micronutrients in plant physiology has been well established. (Marschner, 1999; Epstein and Bloom, 2005). Affordable, meaningful concentrations and effective micronutrients for crop production are limited to synthetics, therefor we support the listing of synthetic micronutrients. However, we wish to express our interpretation of the NOP restriction applied to micronutrients, which states that a deficiency of micronutrients must exist before application is allowed.

Micronutrient deficiencies, especially boron, result in irreparable damage to crops (Epstein, 2005). The requirement for micronutrients varies considerably from crop to crop, soil type, rainfall, region of the country, organic matter content, liming practices, soil texture and soil pH (Mortvedt et al, 1991;Welch, 1995; Borax, 2002; Havlin et al, 1999).

Micronutrient content in complex agroecosystem soils typical of organic agricultural operations needs to be analyzed by integrated analysis (Giampietro, 2004, p. 279), not just content alone because the actual availability of micronutrients within the rhizosphere (root contact zone) of plants does not correlate with conventional chemistry models of soil nutrient requirements (Marschner and Römheld, 1996), especially where soils are managed to increase organic matter levels (Magdoff and Weil, 2004).

Determination of what nutrients are sufficient must take into account the numerous interactions among micronutrients. The interactions of micronutrients may be synergistic or antagonistic, where the physiological effect of two or more micronutrient elements is either greater or less than the effect of either independent micronutrient (Olson, 1972). There are more antagonistic interactions among micronutrients (and macronutrients) than synergistic effects. The major (macro) nutrients calcium, magnesium, phosphorus, potassium, sulfur, nitrogen, sodium and silicon have an antagonistic effect on micronutrients (Kabata-Pendias, 2000).

Current research on sustainable agroecosystems has revealed that increased soil organic matter has such a profound effect on nutrients and soil microflora as well as macro-flora, the edicts of conventional agriculture simply do not apply (Magdoff and Weil, 2004). Instead, new models of sustainability emphasize nutrient balance for the prevention of disease and pest pressure (Phelan, 2004). The mineral balance of soils, probably more so than content alone, is critical to food, forage, ecosystem, livestock and human health.

According to the Organic Food Production Act (OFPA, 1990), the organic plan must "foster soil fertility". The interpretation of what constitutes good soil fertility must be based on sustainable models that address the health of humans as well as soils, plants and livestock. The organic matter content of soils is rapidly becoming one of the standards by which to judge the quality and health of soils. As the knowledge of organic matter interactions with micronutrients increases, it is becoming necessary to review the old concepts of soil mineral deficiency and sufficiency in the context of sustainable ecosystem health.

Maintaining or improving soil nutrient content, instead of waiting for "deficiencies", is consistent with organic plans also. NOP § 205.200 requires a producer to "maintain or improve the natural resources of the operation, including soil and water". In order to utilize natural resources in such a way as to not deplete the soil, we interpret §205.200 to mean that a grower has to replenish nutrients that are carried off fields to maintain sufficient soil nutrient levels as well as supplying nutrients based on models of balance and prevention. Waiting for deficiencies to arise is inconsistent with current mineral balancing models, the goals of organic system plans and good agronomic practices.

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Addendum F

Soluble Boron Products

We support the listing of soluble boron products.

There is more knowledge regarding what happens when boron is deficient than the knowledge regarding the role of boron for proper plant physiological functions, making it the least understood of all mineral nutrients, despite the fact that the requirement for boron is greater than most micronutrients (Marschner, 1999).

Boron occurs naturally in soils as either boric acid, $B(OH)_3$ or borate anion, $B(OH)_4^-$. Both chemical species of boron are highly soluble and easily leached from soils. In alkaline (pH >7) soils, it can be bound to organic matter and clays, making boron deficiencies a widespread plant nutritional disorder (Marschner, 1999). Boron is also carried off fields when forages and grains are harvested. All of these factors contribute to the reports of deficient available soil boron in every state east of the Mississippi and other regions where rainfall exceeds 35” per year (Borax, 2002).

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Addendum G

Sulfates, carbonates, oxides or silicates
of
zinc, copper, iron, manganese, molybdenum, selenium and cobalt.

We support the continuation § 205.601(j)(6)(ii) which appears to state that the sulfate, carbonate and oxide chemical species of micronutrients are acceptable organic soil inputs. We interpret § 205.601 (j) (6) (ii) to simply mean that other chemical species of micronutrients, such as chlorides or sulfides, are not acceptable because of their potential to interfere with the biological and geochemical equilibrium.

We would like to note that in practice, the sulfate species are much preferred because of good plant availability and the importance of sulfur in soil equilibrium processes (Kabata-Pendias, 2000). The carbonate and oxide species lack beneficial sulfur and are of extremely low solubility, acting almost like inert materials in soil systems.

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